



41st Argos Operations Committee Meeting
Saint-Jean-de-Luz, 5-7 June 2007

E-2-4

ARGOSS-4

ARGOS-4 : SUMMARY

1) ARGOS-4 Mission

- Identification of user needs
- Meeting with CLS
- Preliminary discussion with NOAA at intercession (march 07)
- Synthesis of user needs
- Argos-3 Heritage
- Draft of Mission Specification

2) ARGOS-4 System

- Preliminary Overview and system study
- Operational and system constraints
- Preliminary discussions with NGST
- Planning



1) ARGOS-4 MISSION

IDENTIFICATION OF THE USER NEEDS

- CLS User Survey
 - realised in 2006
 - 1376 surveyed customers
 - 238 responses (mainly in oceanography, meteo and biology)
 - it has been asked to evaluate the service and the system, then to propose system enhancements
- NOAA Users consultation
 - report issued end of december 2005
 - Questionnaire sent to 33 people, 20 answers received
- Meetings with CLS to review the users and the priorities
 - Preliminary discussion with NOAA at Intercession (march 07)
 - addition of a specific bandwidth for non-environmental applications

USER NEEDS SYNTHESIS FOR ARGOS 4



- COMPLIANT WITH ARGOS-3: able to process the ARGOS-3 platforms
- ONE-WAY AND TWO-WAY COMMUNICATION DCP (Data Collecting Platform):
 - Low power drain : factor 2
 - Low volume and mass : factor 2
 - High power efficiency for transmitting : factor 2
 - Low power consumption for receiving : constant for increased capacity
- INCREASE DCP DENSITY:
 - Doubled number of platforms among which 25% are @ 4800 bps
 - Increase data volume transmission per pass : up to 100 kb per pass
- IMPROVE LOCATION : 50 to 150 m
- BETTER TIME RESPONSE : Average < 30 min
- INCREASE DOWNLINK DATA VOLUME : > 1,2 kbps

NUMBER OF ACTIVE PLATFORMS IN THE SYSTEM

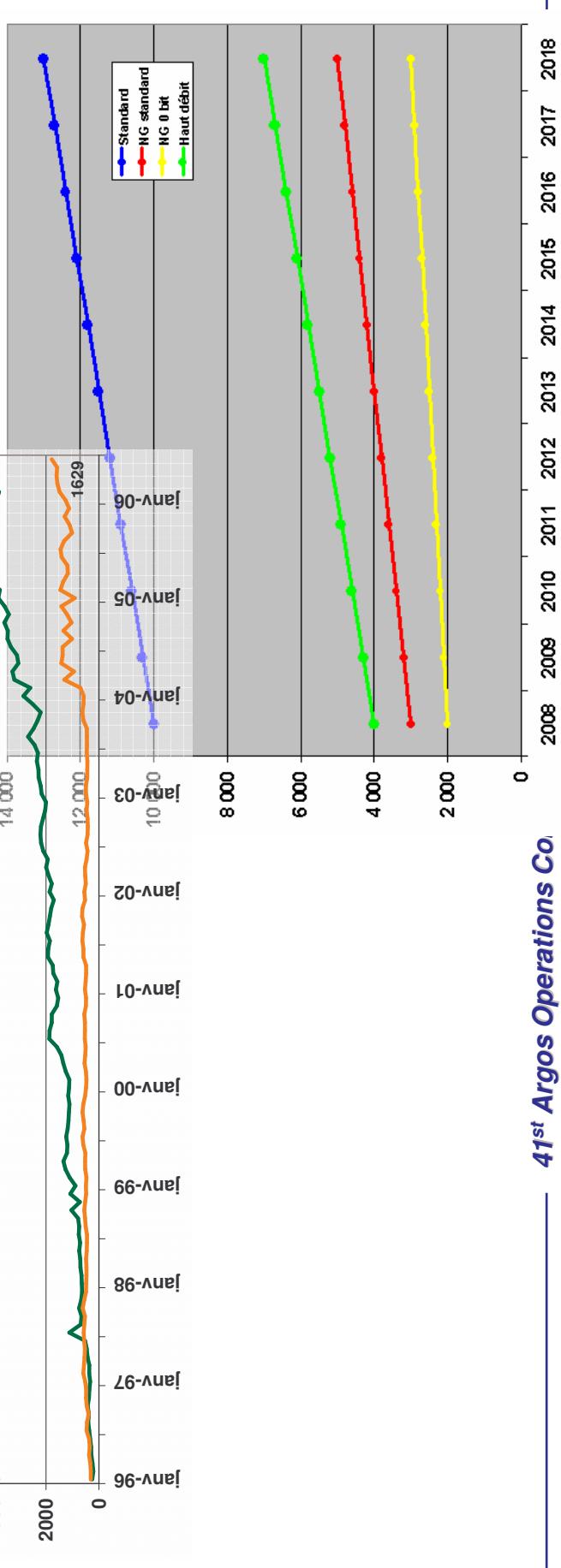
18000
16000
14000
12000
10000
8000
6000
4000
2000
0

Average growth > 12% per year

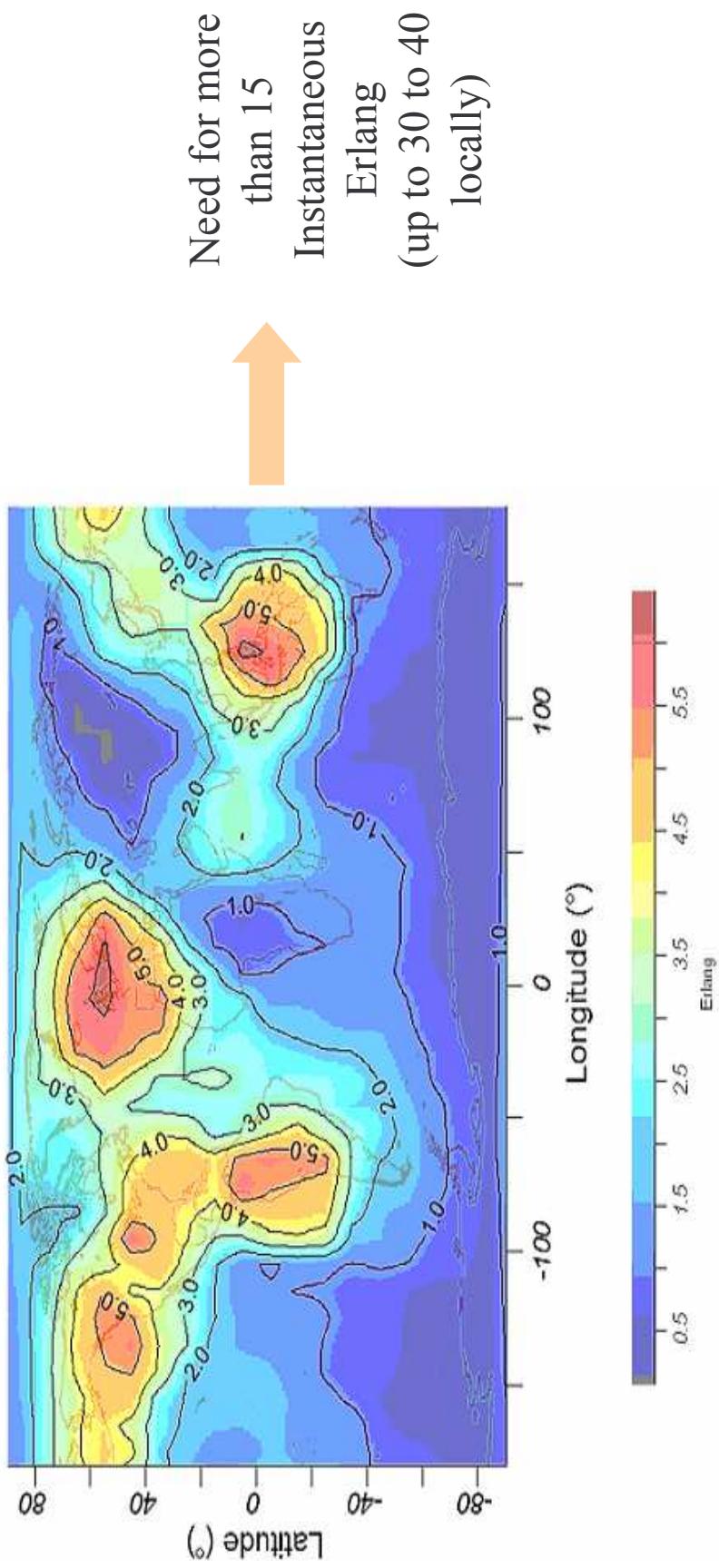
Total ARGOS
Total Science
Total Fishing
Total Sensitive Use

17032
10781
4467
1629
12 000
10 000
14 000

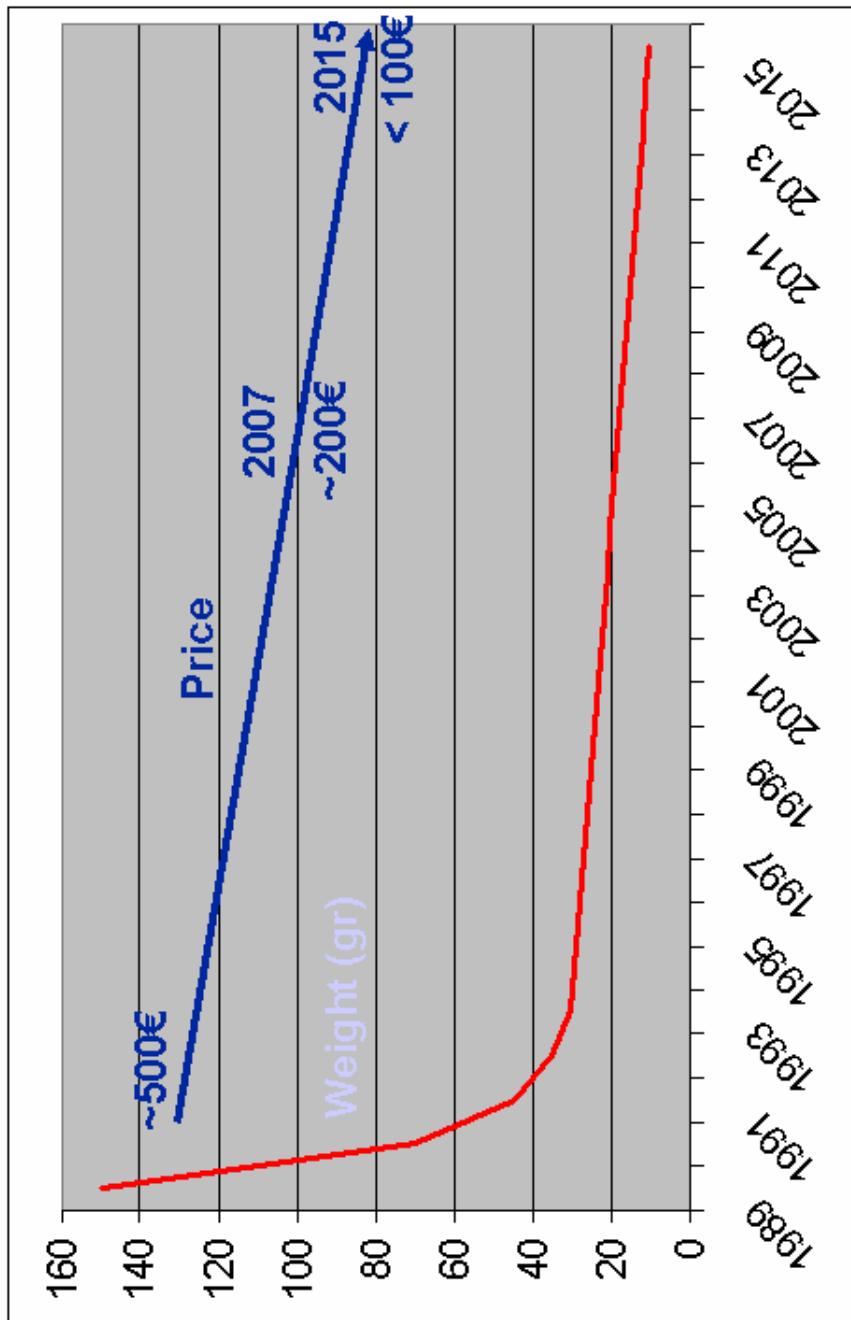
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NEED FOR ADDITIONAL CAPACITY



LESS EXPENSIVE TRANSMITTERS



ARGOS-3 SYSTEM HERITAGE (1/3)



- 401-402 MHz: 110 kHz bandwidth centered on 401.635 MHz (30 kHz for high data rate platforms and 80 kHz for low data rate platforms)
 - Co-Primary status at the International Telecommunication Union
 - Favourable link budget
 - Small and cheap antenna: mainly whip antenna on platforms
- DCP
 - PTT (Platform Transmitter Terminal)
 - o Standard DCP @ 400 bps (Argos-1 & 2 heritage)
 - o New Generation of DCP @ 400 bps available in 2007: 3 to 4 dB link budget improvement, going to reduce average power and power drain
 - o High data volume DCP @ 4800 bps : up to 4608 useful bits per burst

ARGOS-3 SYSTEM HERITAGE (2/3)



- PMT (Platform Message Transceiver): Two-way communications for standard DCP, New Generation DCP and High Data Volume DCP

First generation: Available now



SEIMAC / MARTEC PMT



41st Arg Second generation: Available mid- 2007

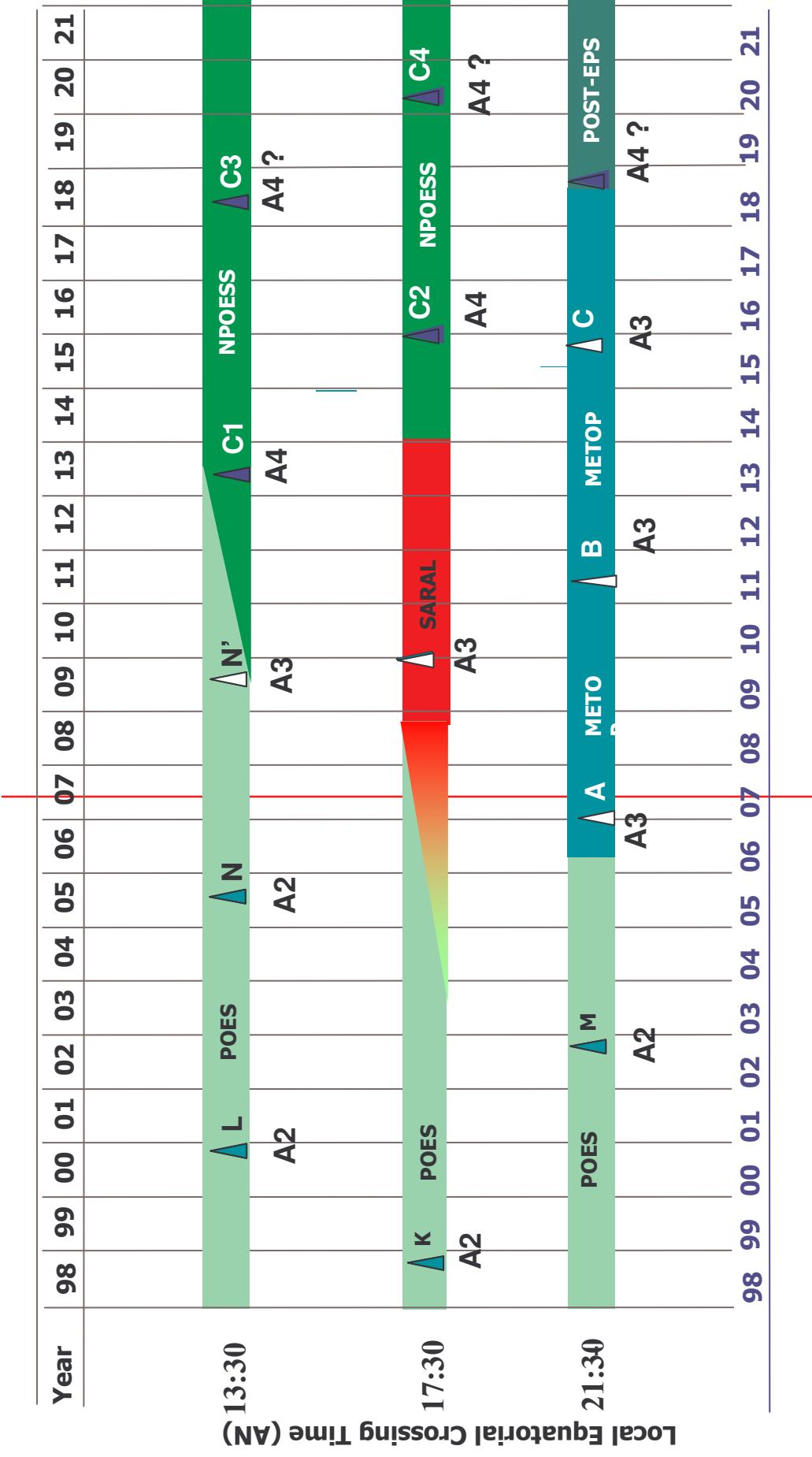
ELTA PMT/PTT -

ARGOS-3 SYSTEM HERITAGE (3/3)



- AUTONOMOUS GEOLOCATION
 - On ground Doppler location : 300 to 400 m
- SIMPLE MULTI-USER ACCESS (as ARGOS-1 and 2)
 - Frequency / Time Random Access (no communication protocol)
 - Robust and simple to operate
- IMPROVED SENSITIVITY w.r.t ARGOS-2 (from -131dBm to -137dBm)
 - DOWNLINK @ 400 bps usage (466 MHz)
 - UTC Time, satellite ephemeris and constellation status broadcasting
 - increase platform lifetime & optimise platform transmission profile
- Interactive Data Collection :
 - secure data collection by acknowledgment for all kind of platforms, potentially increase data volume per pass
- Download specific information define by the user to its DCP

SATELLITE TRANSITION SCHEDULE

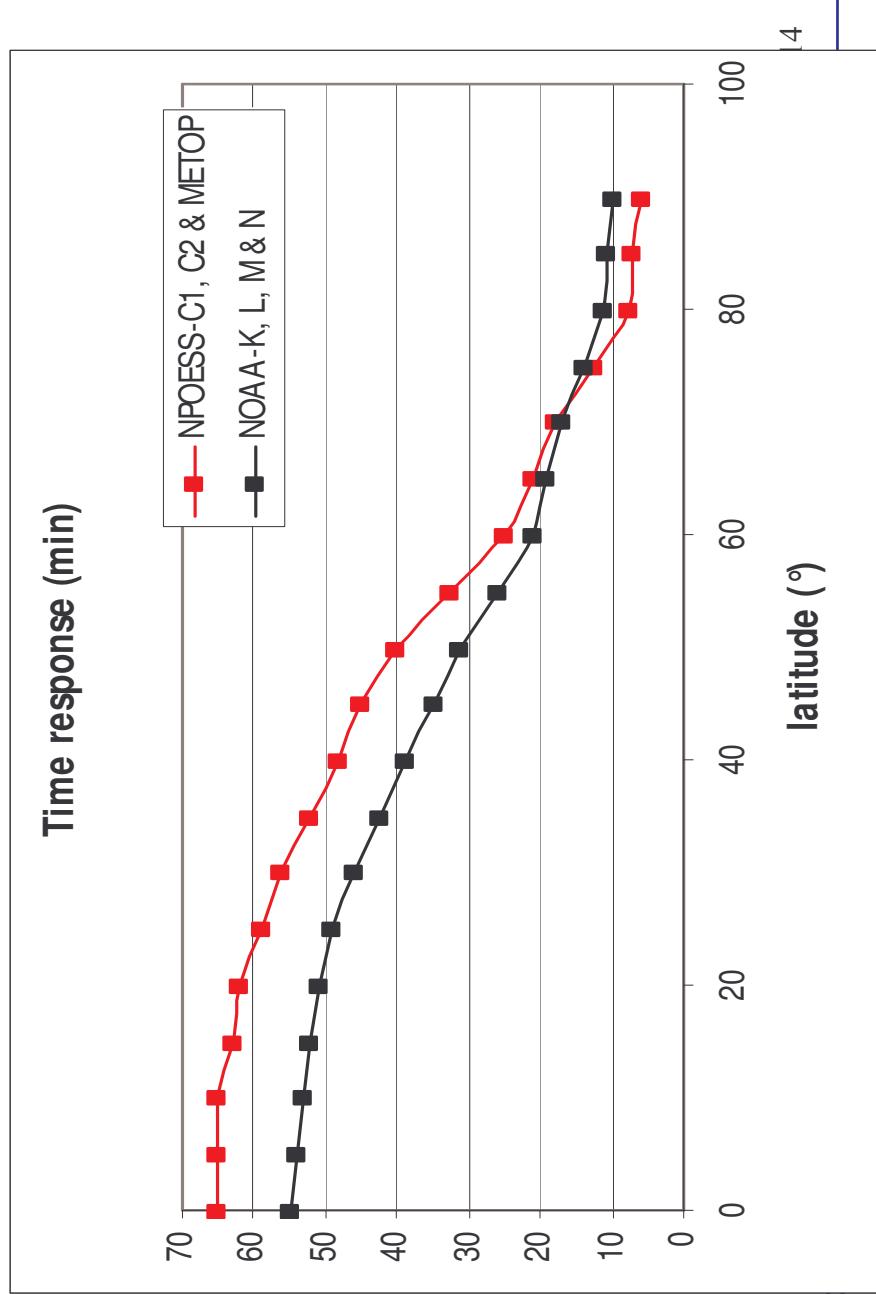




2) ARGOS-4 SYSTEM

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (1/10)

- BASIC SYSTEM CONSTELLATION
 - Reference constellation: NOAA-K, L, M & N
 - NPOESS-C1, C2 and METOP (3 main guarantee orbits)

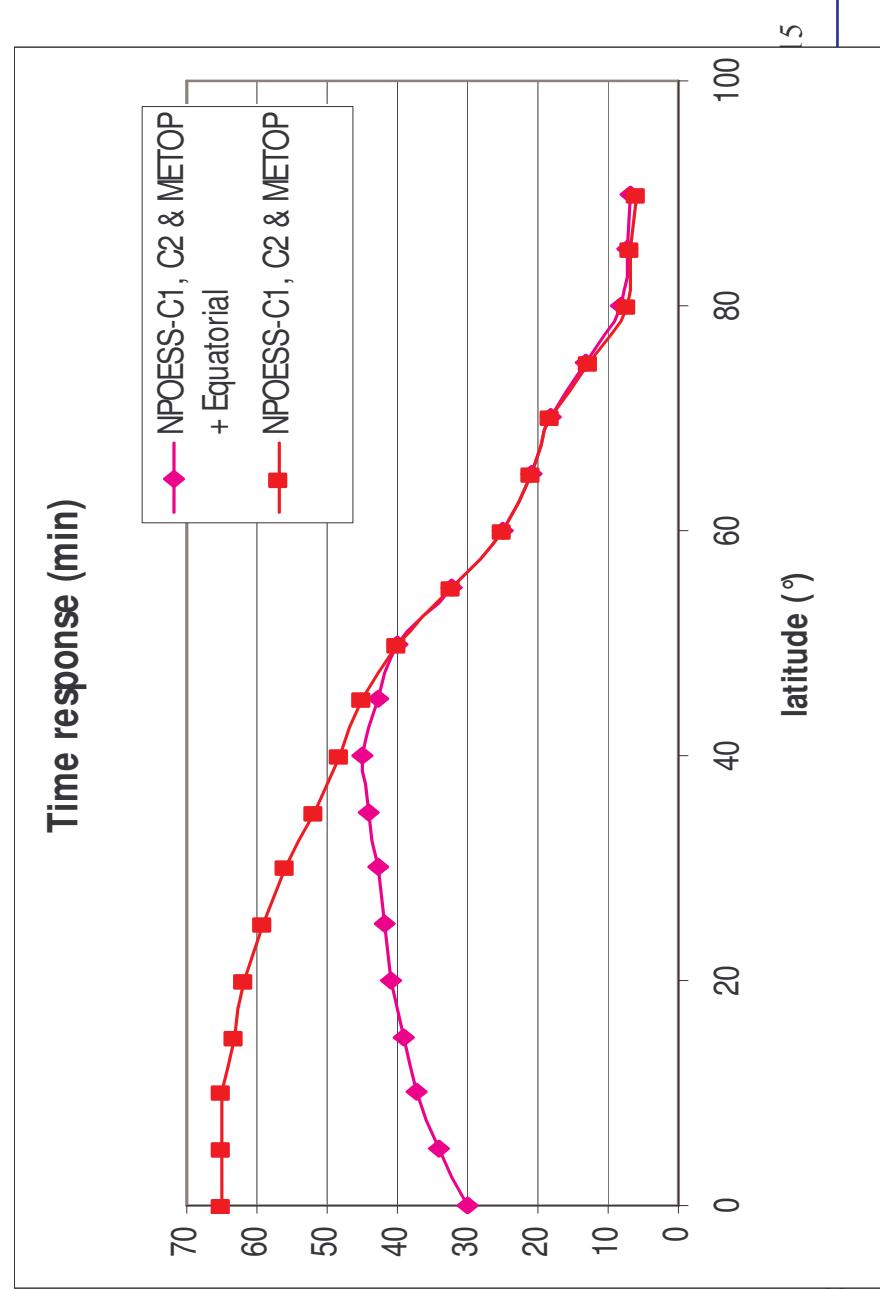


* at equator

Average time response (min)	Maximum Hole per day (hours*)
55	2.5 < MH < 4.7
66	2.9 < MH < 3.7

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (2/10)

- IMPROVEMENT IDEAS
 - Satellite orbit control
 - NPOESS-C1, C2 and METOP + 1 equatorial orbit satellite



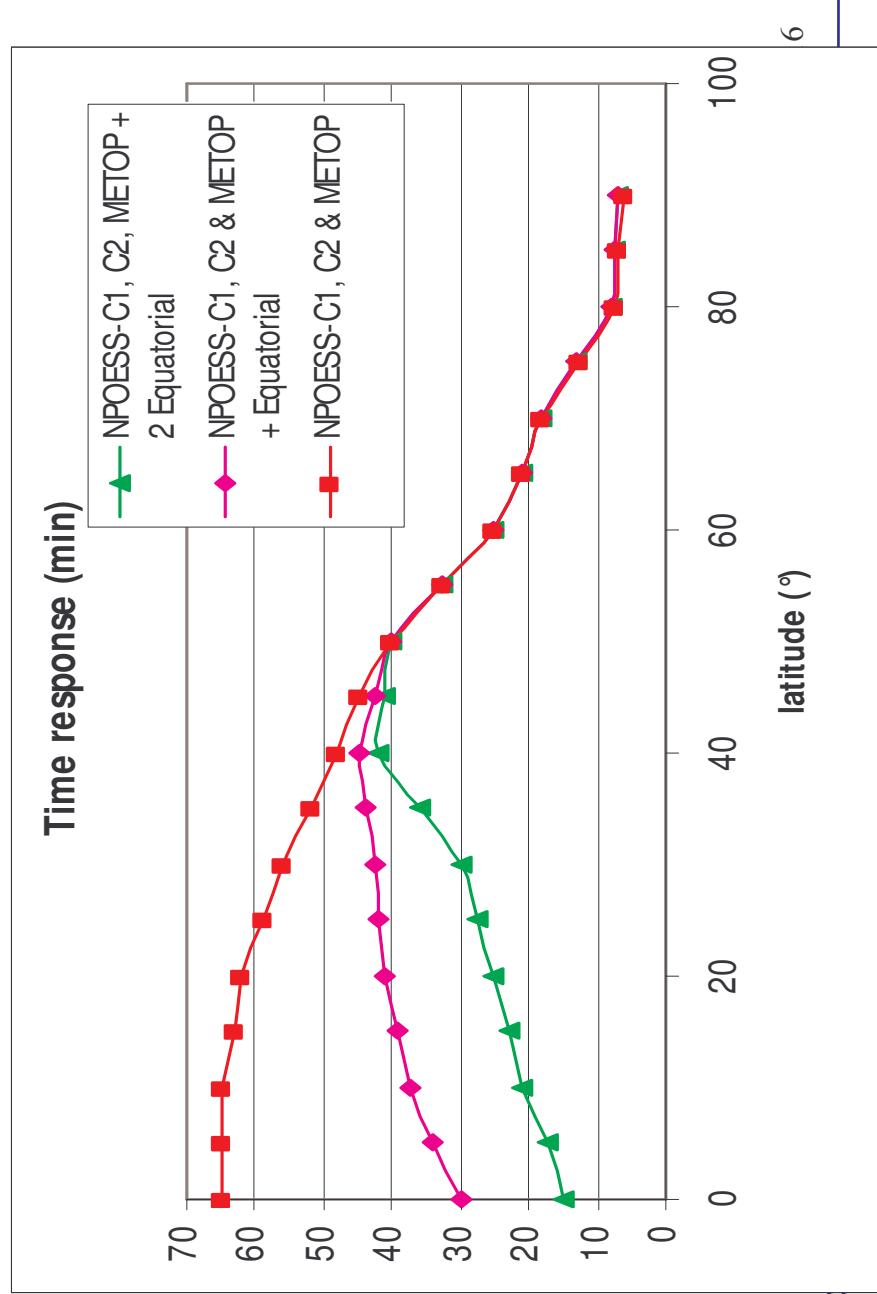
* at equator

Average time response (min)	Maximum Hole per day (hours*)
55	2.5 < MH < 4.7
66	2.9 < MH < 3.7
30	1.6 < MH < 1.7

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (3/10)

- IMPROVEMENT IDEAS

- Satellite orbit control
- NPOESS-C1, C2 and METOP + 2 equatorial orbit satellites



* at equator

Average time response (min)	Maximum Hole per day (hours*)
55	2.5 < MH < 4.7
66	2.9 < MH < 3.7
30	1.6 < MH < 1.7
14	0.7 < MH < 0.8

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (4/10)

- Data Collection Platforms (DCPs)

- ARGOS-3 DCP remain compatible with the system
- No more complexity to allow the cost decrease
- New Generation of High Data volume DCP @ 4800 bps: simple turbo code scheme based on the existing HD DCP
- 3 dB gain on the uplink budget margin, going to reduce average power and power drain
- All High Data Rate Platforms shall be declared as “interactive”. It will be not required to previously register on-board the platform ID.
- Due to the extended bandwidth it is expected to allocate a specific frequency band for low power applications (animal tracking, ...) → better Doppler Geolocation

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (5/10)



- MORE CAPACITY

- New Radhard processor up to 840 Mflops w.r.t ARGOS-3 @ 25 Mflops
- Extended bandwidth from 110 kHz to 600 kHz (TBC): subject to filing submission
- More High Data volume DCPS in the system
- Better platform processing by using multi-user techniques
- More processing units in order to manage
 - low data rate : 10 Erlang in average and 40 Erlang peak
 - high data rate : 3 Erlang in average and 9 Erlang peak
- Dynamic carrier frequency attribution through the downlink (PMT frequency management)

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (6/10)



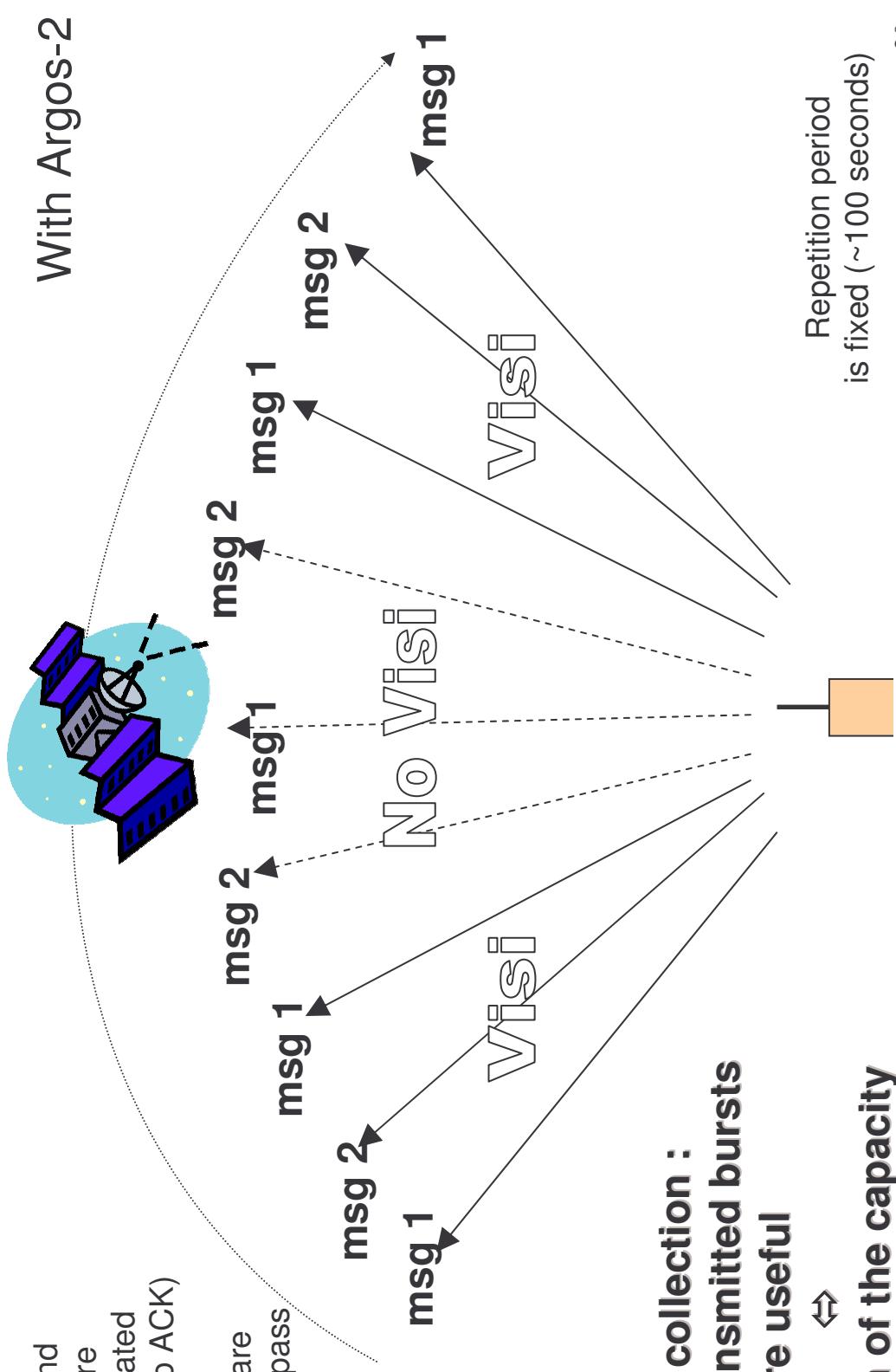
- DOWNLINK

- ARGOS-3 PMT receiver remain compatible with the system
- No more complexity at PMT level
- Reinforce downlink data rate (consistently with the uplink capacity) through a factor 3 on satellite emitted power over an extended bandwidth
- Improving the data bit rate: 3 times more than ARGOS-3 PMT (TBC) for the same characteristics and complexity at PMT level

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (7/10)

Message 1 and message 2 are alternately repeated within the pass (no ACK)

500 bits max are transmitted per pass



**Data collection :
only 2 transmitted bursts
are useful**

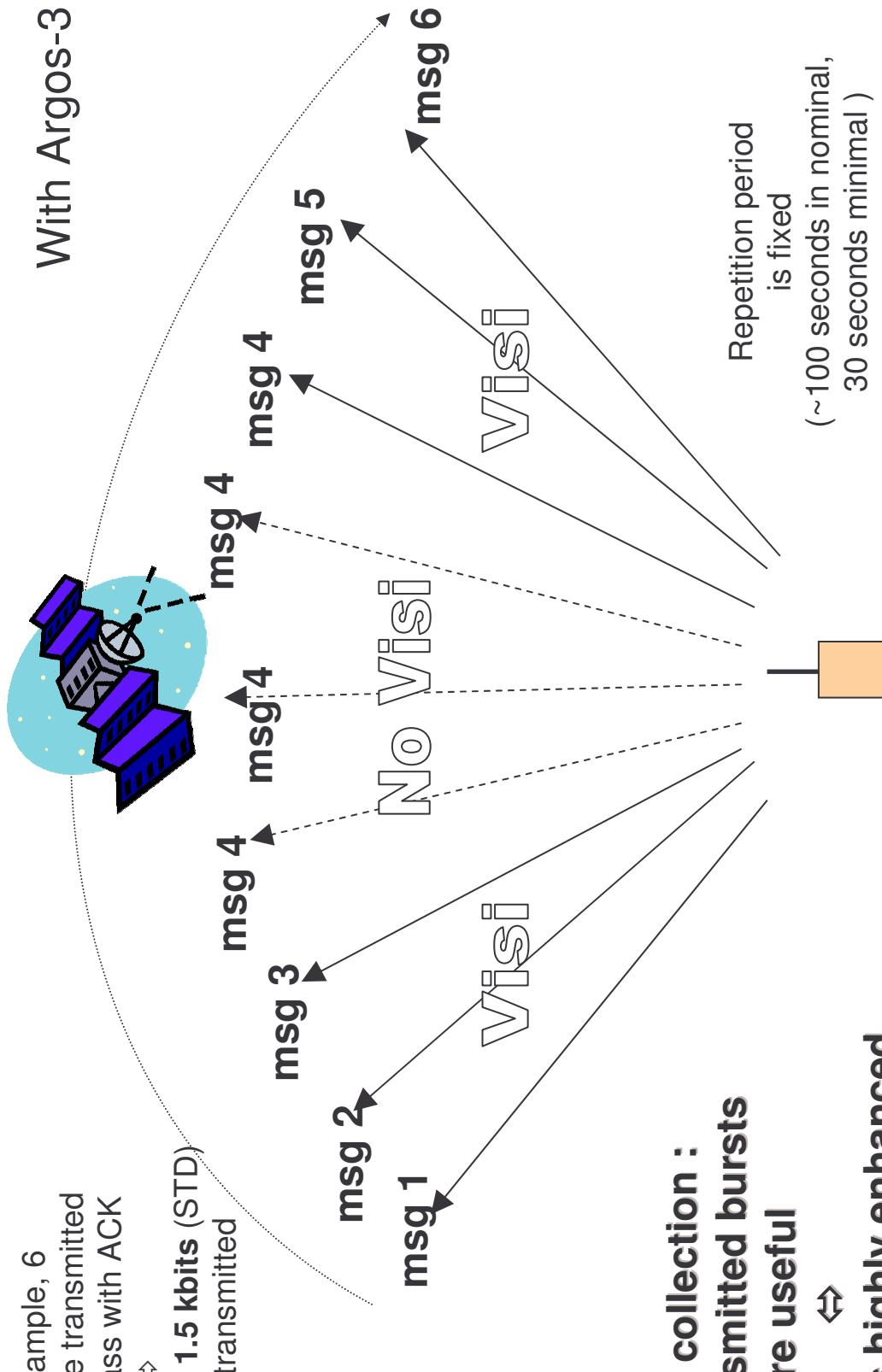
↔

limitation of the capacity

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (8/10)

In this example, 6 messages are transmitted during the pass with ACK

27 kbits (HD) or 1.5 kbits (STD)
have been transmitted



Data collection :
**all transmitted bursts
are useful**



capacity is highly enhanced

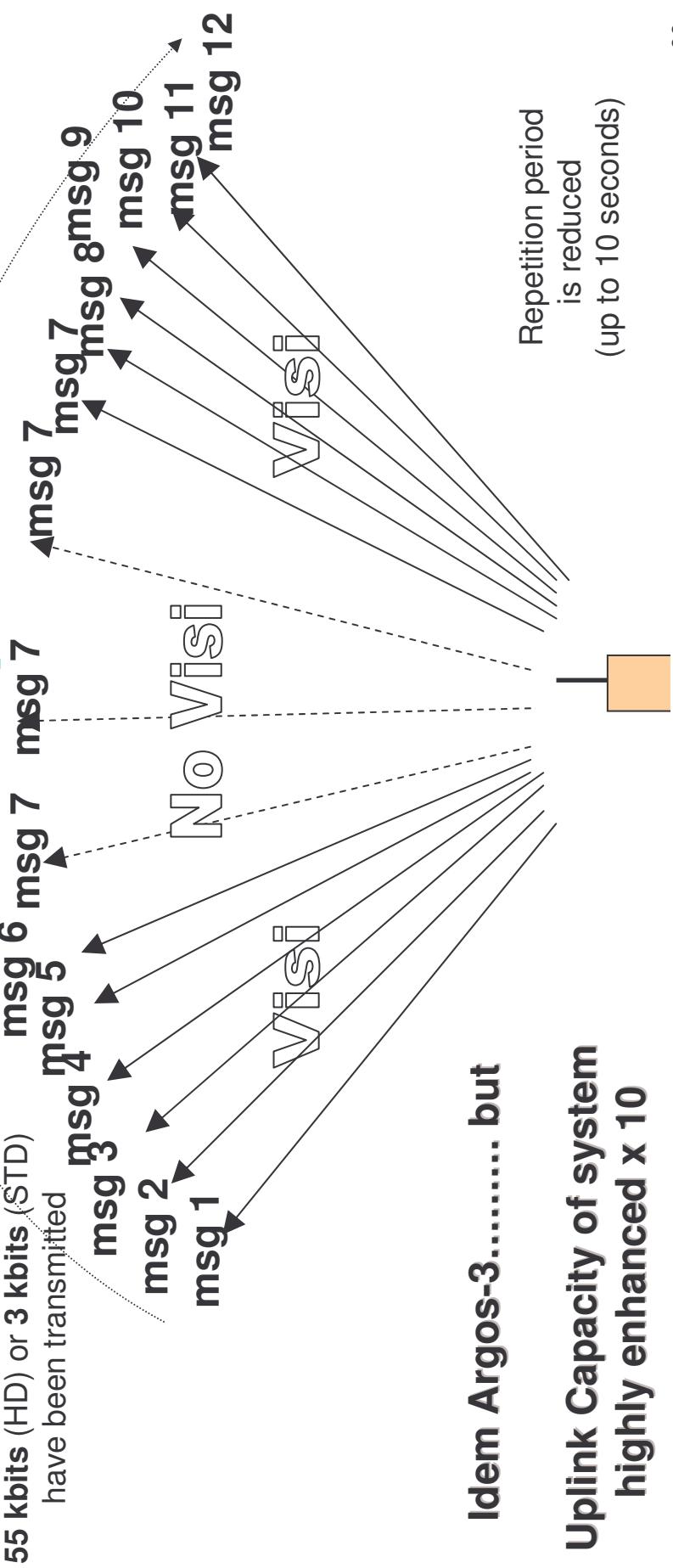
ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (9/10)

In this example, 12 messages are transmitted during the pass with ACK due to the higher available capacity

55 kbytes (HD) or 3 kbytes (STD)
have been transmitted



With Argos-4



Idem Argos-3..... but

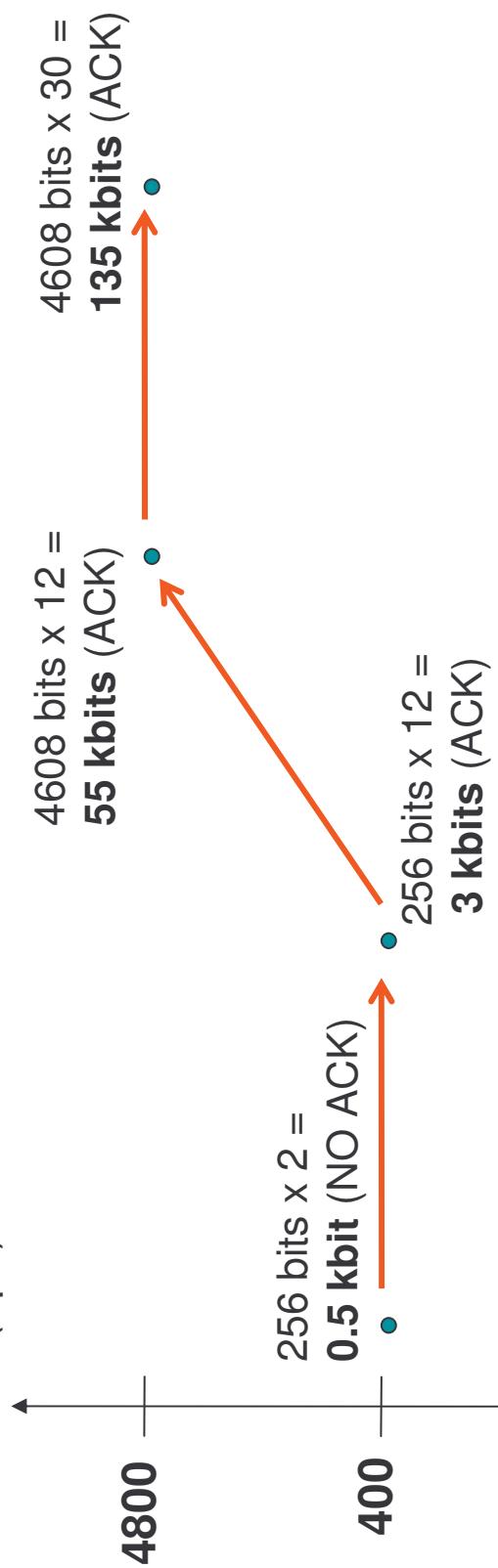
**Uplink Capacity of system
highly enhanced x 10**

ARGOS-4 SYSTEM: PRELIMINARY OVERVIEW (10/10)



- MAXIMUM DATA AMOUNT PER PASS (10 min)

Data Rate (bps)



Argos-2 STD	Argos-3 BD	Argos-3 HD	Argos-4 HD
2 useful bursts per pass *	11 useful bursts per pass *	30 useful bursts per pass *	30 useful bursts per pass **

* for a repetition period = 50 seconds

** for a repetition period = 200 seconds

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ARGOS-4 : OPERATIONAL AND SYSTEM CONSTRAINTS



The new instrument can be considered as an Argos-3 + instrument because:

- Argos-3 instrument not yet used operationnaly
- the users haven't expressed new needs by in term of functionalities
- further development on beacons (PTT/PMT) is not expected
- important constraints :
 - for CNES to find resources at short-term level
 - for NGST (and NOAA) to accept deviation on their I/F and accept delay on CNES procurement (definition, equipments, documentation).
 - for Industry, planning constraints : in the hypothesis the most optimistic, the kick-off of Phase B will be in April 2008 : only 3 years for a full development including simulators, EDU, test bench, flight model, etc.

ARGOS-4 : OPERATIONAL AND SYSTEM CONSTRAINTS

Need to improve the instrument performance in term of signal processing in relation to the noise conditions.

Need to have a spectrum analysis of the Argos bandwidth

- in nominal mode , the bandwidth will be sampled regularly and spectrum samples stored within specific TLM packets (occurency TBD)
- in analysis mode (mode activated during integration –EMC tests for instance - , but possible also in-orbit) data processing will be stopped and only packets with spectrum samples will be continuously downloaded.
- at ground level, it will be possible to manage the frequency distribution of the beacons (dedicated bandwidth for animal tracking applications)

Need to better monitor the management software (direct access to the beacon tables, to the SW status), to optimise the uploading of all SW (management SW and processing SW) and to have a good diagnostic mode .

ARGOS-4 : PRELIMINARY DISCUSSIONS WITH NGST



Main issues with the new instrument at I/F level :

- Extension of the bandwidth : 500/600 kHz instead of 110 kHz
 - to process simultaneously up to 40 LD and 9 HD messages (11 + 1 with Argos-3)
 - can be shared within several bandwidths within 401-403 MHz
 - impact on the accommodation Hardware developed by NGST
 - EMC issue (the band needs to be clean over the 600 kHz)
- Increase of power consumption (80 Watt instead of 60 Watt)
 - impact on the satellite thermal control
 - instrument need to be qualified in [-15° ; +55°]
- New downlink signal (1200 b/s instead of 400 bits/s)
 - the power flux density at ground level is not increased

ARGOS-4 : PRELIMINARY DISCUSSIONS WITH NGST



- New electrical I/F (1553 instead of the old « Ticos » I/F)
 - requirement for software uploading : management AND processing SW
 - increase of telemetry rate
 - CCSDS packets generated by instrument
 - introduction of a diagnostic mode through satellite I/F
- Increase of the Mission Telemetry Data Rate
 - 60 kbit/s in average instead of 15 kbit/s
 - potential difficulty on LRD (real-time link in L-Band)

Nota : Some NGIID non-compliance existing with A-DCS will disappear with Argos-4 (directly taken into account in the instrument requirements given to industry)

ARGOS-4 PLANNING



- Phase A study: November 2006 - December 2007
- Mission Specification reviewed at Opscom 2007
- ICD first version in May 2007 (NGST requirement)
- System Design Review in Februray 2008
- Phase B: April 2008
- ICD finalized in July 2008 (NGST requirement)
release in October 2008
- Instrument PDR (Preliminary Design Review) : October 2008
- Instrument SW Simulator in April 2010
- Engineering Model (EDU) in October 2010
- First Flight Model provided in May 2011
- Launch of NPOESS-C1 on 31 January 2013